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ABSTRACT

Modern educational theory suggests that the learning of a visual science concept is best taught using a combination of pictorial and verbal instruction describing these characteristics and examples and best evaluated using words and visuals not used during instruction. Recent research suggests a four-step instructional-testing model usable by science teachers. First, teachers should display visual concept examples in an orderly and systematic fashion by beginning with uncomplicated pictured models and proceeding to more complex examples. Second, a few frequently confusing nonexamples should be presented to prevent over-generalization. Third, teachers should present brand new examples and nonexamples. And fourth, teachers should construct test questions preferably containing pictured examples and nonexamples not used during instruction. This model is illustrated by applying it to the teaching of a simple visual concept (the triangle).
(Author/BB)

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Using Pictures in the Classroom

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What kinds of drawings and photographs should be used in the science classroom? Research evidence suggests to teachers some surprising guidelines. For example, textbook pictures can actually inhibit learning by diverting some children's attention away from the accompanying text. [1] Further, colored pictures are usually not that much better than black-and-white pictures unless the objective is to teach the color of an object. [2] In fact, some children can attach too much importance to the artificial color used in the picture and become confused when they see the same thing in the real world. [3]

Research suggests ways teachers can use pictures and words in teaching visual science concepts. Visual concepts such as flowers and land forms are seeable categories each with their own characteristics and examples, and describable in visual and verbal "terms" [4] This article describes research findings about teaching such concepts to children; the accompanying bibliography will take the reader further.[1] To date, research suggests fewer guidelines on how to use pictures in the teaching of more abstract science concepts.

Modern educational theory suggests that the learning of a visual science concept is best taught using a combination of pictorial and verbal instruction describing these characteristics and examples and best evaluated

[1] Recommendations should be interpreted as tentative or most probable in terms of general research findings about elementary school children. It is hardly possible to derive perfect instructional generalizations about science pictures by simply following a chart, table, or set of rules. Such decisions can only be made by intelligent, experienced teachers.

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using words and visuals not used during instruction. [5] Visual illustrations of concepts used in science class usually come in two forms - line drawings (diagrammatic and realistic) and photographs. First, line drawings emphasize important characteristics of science concepts such as different kinds of plants and animals. [6] Specifically, diagrammatic line drawings can highlight and define the most important characteristics [7] while realistic line drawings can help children to identify real-life examples in a more natural setting. [8] Such line drawings should be verbally labelled by children, whenever possible, as the teacher explains illustrated concepts. [9] Such student participation can increase the likelihood that children are paying attention and can help them remember relationships between a concept's characteristics and its pictured (diagrammatic or realistic) examples. [10] However, it is important to remember that verbally troubled children can have problems using diagrammatic visuals [11], while higher ability children can more effectively use schematic or diagrammatic pictures. [12] In addition, some detail and complexity in either drawing type are required so children can make visual sense out of the picture but too much detail can clutter children's thinking with unnecessary complexity. [13] Second, photographic examples used with line drawings can be particularly effective in providing an even more realistic picture of visual concepts placed in their usual complex environment. [14]

Recent research suggest a four-step instructional-testing model useable by science teachers. [15, 16] Of course, there exist infinite strategy variations for implementing this generalized model.

First, (example step), teachers should display visual concept examples in an orderly and systematic fashion by beginning with uncomplicated pictured exemplars and proceeding to more complex examples. Using this technique, teachers (verbally and physically) can emphasize the most dominant concept characteristics followed by the presentation of the more subtle concept characteristics.

Second, (nonexample step), the teacher should present a few frequently confusing nonexamples in a similar fashion (whenever applicable) so as to prevent students from over-generalizing the instructional examples to similar nonexamples of science concepts found in the real world.

Third (feedback step), teachers should present brand new examples and nonexamples, and ask children to discriminate between the two types and also to provide reasons for their decisions. In fact, such feedback discussions within all phases of instruction can help teachers determine in individual classroom cases the appropriateness of a chosen teaching strategy.

Fourth (testing step), teachers should construct test questions preferably containing pictured examples and nonexamples not used during instruction. Children should be asked to distinguish between these two visual-example types and in some cases to answer verbal questions not merely testing their ability to memorize key descriptive words used during instruction.

Perhaps, the best way to illustrate this four-step model is to describe briefly how to teach a simple visual concept (triangle). The described steps can be easily integrated into those procedures recommended in Science - A Process Approach II, Module Two ("Recognizing and Using Shapes).

First (example step), display in increasing complex order many diagrammatic figures of triangles having various sizes and orientations. Then, similarly present photographs of many triangle examples placed in their natural settings (which contain increasingly more distracting visual elements). Be sure to focus children's attention in a physical and verbal manner on the important concepts and characteristics pictured in each example.

Second (nonexample step), display fewer nonexamples (e.g., squares and "traditional" rectangles) of triangles in an analogous manner. Make sure children understand why the nonexamples do not belong to the concept, triangle.

Third (feedback step), display a similar mixture of easy - and then difficult-to-distinguish groups of examples and nonexamples not used in steps one or two. Ask children to classify the example types and to tell you why their groupings are correct.

Fourth (testing step), repeat the feedback step using new material and record the children's responses.

The same model can also be used to teach more abstract visual concepts such as those taught in SAPA II Modules 12 ("Three-Dimensional Shapes") and 29 ("shadows") and other verbally abstract concepts such as those predator-prey and habitat-niche relationships described in Science Curriculum Improvement Study. These more abstract concepts are best taught by increasing children's attention to the verbally expressable characteristics of each pictured example, while decreasing their attention to the visual characteristics.

Finally, a judicious contribution of visual and verbal instruction can

help children better understand how to perform classroom activities requiring hands-on manipulation of science materials by illustrating correct procedures using realistic line drawings with diagrammatic arrows and verbal labels. [17] Specifically, a pictured procedure should be self-explanatory and not require the reader to (constantly) bounce back and forth from the text to the illustration.

Learning From Pictures

How do children learn science from pictures? No one knows. [18] Many research studies of previous decades were of poor quality [4] and concluded that when pictures are used adjacent to printed texts, they did not facilitate comprehension. [17] However, recent research [15] suggest pictures can help children comprehend specific science concepts and experimental procedures. Indeed, today's researchers are investigating more sophisticated questions such as whether or not pictures with textual and oral presentations help children understand by independently contributing information, by helping them organize information, or by merely convincing children to rehearse or memorize those pictures presented with the verbal instruction.

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